First, a set of baseline measurements will be established. This baseline will be the performance of the analog main channel with no IBOC present. After characterization of the analog service, IBOC will be added to the host channel and performance will be re-evaluated. Comparison of these results with the baseline measurements will provide a characterization of the effect of IBOC on the host channel.

Table 4-7 and Table 4-8 list the scenarios included in host compatability testing with objective and subjective evaluation.

Table 4-7 Host Compatability; Objective (NRSC L)

#	Strength	Mode
0057	Strong	Analog
0058	Strong	Hybrid
0059	Moderate	Analog
0060	Moderate	Hybrid
0061	Weak	Analog
0062	Weak	Hybrid

Table 4-8 Host Compatability; Subjective (NRSC L)

#	Multipath Scenario	Strength	Mode
1109	Urban Slow	Strong	Analog
1110	Urban Fast	Strong	Analog
1111	Urban Slow	Moderate	Analog
1112	Urban Fast	Moderate	Analog
1113	Urban Slow	Weak	Analog
1114	Urban Fast	Weak	Analog
1115	Urban Slow	Strong	Hybrid
1116	Urban Fast	Strong	Hybrid
1117	Urban Slow	Moderate	Hybrid
1118	Urban Fast	Moderate	Hybrid
1119	Urban Slow	Weak	Hybrid
1120	Urban Fast	Weak	Hybrid

Setup

Refer to Appendix G for detailed test bed diagrams.

The noise floor shall be established at a constant 100,000°K. There shall not be any adjacent channel or co-channel interferers present.

The analog and hybrid signals shall comply to the definitions established in sections 2.1.1 and 2.1.3, respectively.

Procedure (Objective Evaluation)

1) Apply the desired analog signal, as defined in 2.1.1, to the receiver. This signal should have a 'strong' power level (-47dBm).
2) On the main channel, collect S/N and THD+N measurements according to section 3.2.1 and 3.2.2.

3) Remove the analog signal from the receiver, and apply an IBOC hybrid signal, as defined in 2.1.3.
4) Repeat step 2 for the hybrid signal.
5) Repeat steps 1 thru 4 using 'moderate' and 'weak' desired signals

Presentation of Data (Objective Evaluation)

The S/N and THD+N measurements shall be presented in the formats described in their respective subsections. Since there is no D/U ratio to be stepped in this case, there are no curves to develop and the results shall be presented in a numerical or bargraph format, which compares measurements *with* IBOC present to measurements *without* IBOC present.

Procedure (Subjective Evaluation)

1) Set the desired channel audio processor to apply 'General Purpose 2B Processing' (see Appendix B for exact processor settings).
2) Load the 'Bypass' scenario into the multipath simulator
3) Apply the appropriate desired signal to the receiver as specified by the test grid.
4) Load the necessary multipath scenario into the simulator (Urban Slow or Urban Fast).
5) Start the multipath simulation.
6) Modulate the desired channel with the critical listening material
7) Record the output of the receiver under test (RUT) to DAT tape.

Presentation of Data (Subjective Evaluation)

The data which results from these tests shall be digital audio recordings. Individual cuts/tests on the recordings shall be easily accessible, and identified with unique time code. A list shall be generated which relates test number to DAT time code number. In addition, the DAT time code shall contain the date within the time code user bit.

A. Appendix A - List of Receivers Under Test

The receivers listed in Table A-1 shall be used for compatibility tests. These are the same receivers to be used in USADR's Field Tests. Table A-2, Table A-3, and Table A-4 specify the configuration of each receiver

Table A-1 Receivers Under Test

Category	Make and Model	Serial Number
Auto	Delco 16195161	89BKRMM38293G378
Home Hi-Fi	Yamaha HTR-5130	Y025169QS
Portable	Philips AZ1020/17	KT009917021837

Table A-2 Delco Automobile Receiver Setup

Model: Delco 16195161	
Parameter	**Description**
Point of Measurement	Front Left Speaker Output
Audio Output Matching Network	L Spkr→4 ohm Load→Transformer→19kHz LPF→Test Bed
Output Level (Volume)	1 Watt (2Vrms) into 4 ohm Load; Measured with 1kHz tone @ 75kHz deviation (no subcarriers)
Antenna Input Matching Network	Dummy Antenna Network (custom from Delco). Input-Z to dummy antenna = 50 ohms
Power Supply	12.0 VDC external power supply
Balance	Center
Fade	Center
Tone/EQ	Flat (detent) position

Notes:

- For subjective tests, the 19kHz filter is removed and both the Left and Right front channels are used.
- RF Power is specified as *power delivered to the dummy antenna.*

Table A-3 Yamaha Home Hi-Fi Receiver Setup

Model: Yamaha HTR-5130	
Parameter	**Description**
Point of Measurement	'Tape Out' RCA jack
Audio Output Matching Network	Tape Out→19kHz LPF→-10 to +4 conversion→Test Bed
Output Level (Volume)	Not adjustable
Antenna Input Matching Network	50→75 ohm min. loss pad
Power Supply	110 VAC
Balance	Center
Fade	Center
Tone/EQ	Flat
Misc.	DSP Processing Off

Notes:
- For subjective tests, the 19kHz filter is removed and both the left and right channels are used
- Tuner is left in "auto/stereo" mode. Note that tuner will *not* automatically switch to mono.

Table A-4 Philips Portable Boombox Setup

Model: Philips AZ1020/17	
Parameter	**Description**
Point of Measurement	Headphone jack
Audio Output Matching Network	Hdph Out→19kHz LPF→Test Bed
Output Level (Volume)	1.0Vrms across a high-z load Measured with 1kHz tone @ 75kHz deviation (no subcarriers)
Antenna Input Matching Network	50→75 ohm min. loss pad
Power Supply	Battery
Tone/EQ	'Hyperbass' off

Notes:
- For subjective tests, the 19kHz filter is removed and both the left and right channels are used

B. Appendix B – Audio Processor Settings

Table B-1 specifies the complete setup of the Orban audio processor and stereo generator. These are the parameters used during subjective testing, i.e. this is 'General Purpose 2B Processing'. The reader will note that Sections 2.2.1 and 2.2.2 specify different setups for the purpose of recording clipped pink noise and processed rock.

Table B-1 Stereo Generator and Processor – General Purpose Processing

Model: Orban Optimod-FM 2200-D
S.N.: 738106-023 JH

The following setup shall be used for the desired channel during subjective tests. This setup is a factory preset known as: 'General Purpose 2B Processing'.

Type	Description	Setting	Notes
Switch	Gnd Lift	Lift	Lift circuit ground from chassis ground
Jumper	J302, J303, J306,J307, J308	"PAD" position	Set input sensitivity of left and right inputs: '+27dBu to +5dBu' peak
Jumper	JA,JB	0 Ohm position	Set composite output to Low-Z
Jumper	J301,J305	"Out" position	Set audio input to High-Z
Menu	EQ→30Hz HPF	In	
Menu	EQ→Low Pass	+1dB	
Menu	EQ→HF Enhance	+2	
Menu	Less-More	5.0	
Menu	Gate Thres.	-40dB	
Menu	AGC	On	
Menu	AGC Drive	10dB	
Menu	2B Drive	18dB	
Menu	Release Time	3dB/s	
Menu	Bass Coupling	55%	
Menu	HF Limit	-1.5	
Menu	Clipping	-2.3	
Menu	Final Clip	+0.5	
Menu	I/O→Input	Analog	
Menu	I/O→Analog In→AI Ref VU	+4.0dBu	
Menu	I/O→Analog In→AI Ref PPM	+12.0dBu	
Menu	I/O→Analog In→AI Clip	+27.0dBu	
Menu	I/O→Digital In→DI Ref. VU	-18.0dBFS	
Menu	I/O→Digital In→DI Ref PPM	-10.0dBFS	
Menu	I/O→AnalogOut→ AO 100%	+4.1dBu	
Menu	I/O→AnalogOut→AO preemph	Pre-emph	
Menu	I/O→Digital Out→DO 100%	0.0dBFS	
Menu	I/O→Digital Out→DO preemph	Pre-emph	
Menu	I/O→Digital Out→DO Rate	44.1kHz	

Model: Orban Optimod-FM 2200-D S.N.: 738106-023 JH			
The following setup shall be used for the desired channel during subjective tests. This setup is a factory preset known as: 'General Purpose 2B Processing'.			
Type	**Description**	**Setting**	**Notes**
Menu	I/O→Digital Out→DO Sync	Internal	
Menu	Stereo Enc→Preemphasis	75uS	
Menu	Stereo Enc→Mode	Stereo	
Menu	Stereo Enc→Pilot Level	9.3%	
Menu	Stereo Enc→Xtalk Test	Normal	
Menu	Test→Mode	Operate	
Menu	Test→Tone	1000Hz	
Menu	Test→Bypass Gain	+15dB	

C. Appendix C - Multipath Scenarios

There are three multipath scenarios used in this test plan: 1) Bypass 2) Urban Slow 3) Urban Fast.

'Bypass' is not really a multipath scenario, but rather a configuration used for calibration. The 'Bypass' scenario is used when initially setting power levels and D/U ratios. After these levels have been set using 'Bypass', either the Urban Slow or Urban Fast scenarios are loaded into the simulator.

The Urban Slow and Urban Fast scenarios are based on the configurations used by the EIA in the 1995 tests. The EIA scenarios specify a total of nine (9) paths. Since there are three channels in the test bed, (desired, undesired #1, and undesired #2) a total of twenty seven (27) paths would be required in order to fully implement these scenarios (such that each channel was uncorrelated to another). This represents a tremendous amount of hardware. A decision was therefore made to implement the full EIA scenario on the desired channel, but implement a 'trimmed' version of the EIA scenarios on the undesired channels.

The 'trimmed' scenarios were produced by starting with the full EIA scenarios and then removing the three paths with the most attenuation. These trimmed scenarios are then used on the undesired channels[7].

The tables that follow list the scenarios for the desired and undesired channels.

Table C-1 Bypass Multipath Scenario (For Calibration)

Path #	Fading Type	Speed (km/hr)	Loss (dB)	Delay (us)	Phase (degrees)	Correlation
1	Doppler	0.00	0.0	0.0	0.0	None
Simulation Duration: 5.0 minute; continuous loop Initial Delay: 0.0 nsec AGC: Hold						

[7] The reader should note that even in the original 1995 EIA tests, there was not enough hardware available to implement the full scenarios on every channel. In addition, it is expected that the trimmed scenarios will actually represent a *stronger* interferer than would be the case with a nine path interferer.

Table C-2 Urban Slow Multipath Scenario (Desired Channel)

Path #	Fading Type	Speed (km/hr)	Loss (dB)	Delay (us)	Phase (degrees)	Correlation
1	Rayleigh	2.00	2.0	0.0	0.0	None
2	Rayleigh	2.00	0.0	0.2	0.0	None
3	Rayleigh	2.00	3.0	0.5	0.0	None
4	Rayleigh	2.00	4.0	0.9	0.0	None
5	Rayleigh	2.00	2.0	1.2	0.0	None
6	Rayleigh	2.00	0.0	1.4	0.0	None
7	Rayleigh	2.00	3.0	2.0	0.0	None
8	Rayleigh	2.00	5.0	2.4	0.0	None
9	Rayleigh	2.00	10.0	3.0	0.0	None
Simulation Duration: 1.5 minute; continuous loop Initial Delay: 0.0 nsec AGC: Hold						

Table C-3 Urban Fast Multipath Scenario (Desired Channel)

Path #	Fading Type	Speed (km/hr)	Loss (dB)	Delay (us)	Phase (degrees)	Correlation
1	Rayleigh	60.00	2.0	0.0	0.0	None
2	Rayleigh	60.00	0.0	0.2	0.0	None
3	Rayleigh	60.00	3.0	0.5	0.0	None
4	Rayleigh	60.00	4.0	0.9	0.0	None
5	Rayleigh	60.00	2.0	1.2	0.0	None
6	Rayleigh	60.00	0.0	1.4	0.0	None
7	Rayleigh	60.00	3.0	2.0	0.0	None
8	Rayleigh	60.00	5.0	2.4	0.0	None
9	Rayleigh	60.00	10.0	3.0	0.0	None
Simulation Duration: 1.5 minute; continuous loop Initial Delay: 0.0 nsec AGC: Hold						

Table C-4 Urban Slow 'Trimmed' Multipath Scenario (Undesired Channels)

Path #	Fading Type	Speed (km/hr)	Loss (dB)	Delay (us)	Phase (degrees)	Correlation
1	Rayleigh	2.00	2.0	0.0	0.0	None
2	Rayleigh	2.00	0.0	0.2	0.0	None
3	Rayleigh	2.00	3.0	0.5	0.0	None
4	Rayleigh	2.00	2.0	1.2	0.0	None
5	Rayleigh	2.00	0.0	1.4	0.0	None
6	Rayleigh	2.00	3.0	2.0	0.0	None

Simulation Duration: 1.5 minute; continuous loop
Initial Delay (Note that this provides a time offset between all the channels)
a) For Undesired #1 → 400.0 nsec
b) For Undesired #2 → 200.0 nsec
AGC: Hold

Table C-5 Urban Fast 'Trimmed' Multipath Scenario (Undesired Channels)

Path #	Fading Type	Speed (km/hr)	Loss (dB)	Delay (us)	Phase (degrees)	Correlation
1	Rayleigh	60.0	2.0	0.0	0.0	None
2	Rayleigh	60.0	0.0	0.2	0.0	None
3	Rayleigh	60.0	3.0	0.5	0.0	None
4	Rayleigh	60.0	2.0	1.2	0.0	None
5	Rayleigh	60.0	0.0	1.4	0.0	None
6	Rayleigh	60.0	3.0	2.0	0.0	None

Simulation Duration: 1.5 minute; continuous loop
Initial Delay (Note that this provides a time offset between all the channels)
a) For Undesired #1 → 400.0 nsec
b) For Undesired #2 → 200.0 nsec
AGC: Hold

D. Appendix D - Calibration Forms

As described in 1.3.2, the test engineer will perform a daily calibration routine. A permanent record of this routine shall be made using the example form shown below.

Figure D-1 illustrates an example of a calibration plot. These plots shall be made as indicated by the calibration form, and will supplement the daily calibration records.

Instrumentation

Certified By:			**Date:**
Equipment	**Complete**	**Incomplete**	**Notes**
HP437B Power Meter (Preset, Zero and Cal.)			
Automation Computer – Time and Date			
Time Code Generator – Time and Date			
Spectrum Analyzer – Time and Date			
Special Notes:			

Desired Channel

Certified By:		**Date:**	
RF Power	**Value**	**Notes**	
Max. Analog Avg. Power (dBm)			
Max. Digital Avg. Power (dBm)			
Analog-to-Digital Ratio (dB)			
Deviation	**Value**	**Notes**	
Pilot Injection (%)			
57kHz SCA Injection (%)			
67kHz SCA Injection (%)			
92kHz SCA Injection (%)			
Total Modulation (Peak %)			
Spectrum Plots	**Complete**	**Incomplete**	**Notes**
Mode: Analog Modulation: 1kHz; Total=110% Display: Averaged SCA: All On			
Mode: Hybrid Modulation: None Display: Averaged SCA: All On			

Certified By:	Date:
Special Notes:	

Undesired #1 Channel

Certified By:		Date:	
RF Power	**Value**	**Notes**	
Power Amplifier Vcc (Volts)			
Max. Analog Avg. Power (dBm)			
Max. Digital Avg. Power (dBm)			
Analog-to-Digital Ratio (dB)			
Deviation	**Value**	**Notes**	
Pilot Injection (%)			
57kHz SCA Injection (%)			
67kHz SCA Injection (%)			
92kHz SCA Injection (%)			
Total Modulation (Peak %)			
Spectrum Plots	**Complete**	**Incomplete**	**Notes**
Mode: Hybrid Modulation: None Display: Averaged SCA: All On			
Mode: Analog Modulation: Clipped Pink Noise Display: Peak Hold SCA: All On			
Special Notes:			

Undesired #2 Channel

Certified By:		Date:
RF Power	**Value**	**Notes**
Power Amplifier Vcc (Volts)		
Max. Analog Avg. Power (dBm)		
Max. Digital Avg. Power (dBm)		
Analog-to-Digital Ratio (dB)		
Deviation	**Value**	**Notes**
Pilot Injection (%)		
57kHz SCA Injection (%)		
67kHz SCA Injection (%)		

Certified By:		Date:	
92kHz SCA Injection (%)			
Total Modulation (Peak %)			
Spectrum Plots	**Complete**	**Incomplete**	**Notes**
Mode: Hybrid Modulation: None Display: Averaged SCA: All On			
Mode: Analog Modulation: Clipped Pink Noise Display: Peak Hold SCA: All On			
Special Notes:			

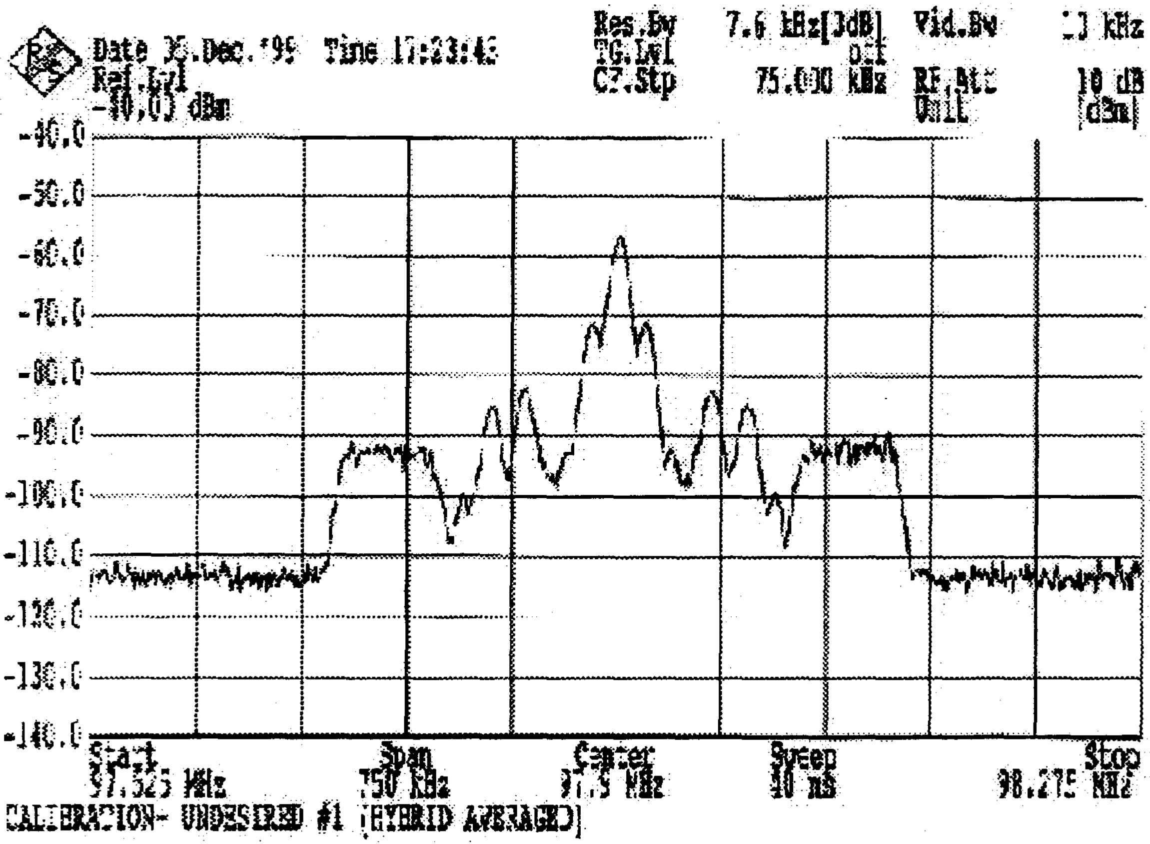
Noise

Certified By:		Date:
Parameter	**Value**	**Notes**
Intentional Noise Energy (dBm/1MHz *without* Band-Pass Filter)		
Special Notes:		

Radio Under Test

Certified By:		Date:
Parameter	**Value**	**Notes**
Audio Output with 75kHz Deviation by 1kHz tone (V_{RMS})		
Power Supply (V_{RMS})		
Antenna Input – Matching Network		
Audio Output – Matching Network		
Special Notes:		

Figure D-1 Example of a Daily Calibration Plot



E. Appendix E - Definition of Units

The following definitions shall be applied to the measurement units, which will be reported. Additional definitions shall be included and documented as required.

dBm: A unit of expression of power level in decibels with reference to a power of one milliwatt.

dBu (audio context): dBu is decibels referred to a voltage of 0.7746 volts; it does not imply any value of circuit impedance or power. The value of 0.7746 volts is the voltage across a 600 ohm resistor when exactly one milliwatt is being dissipated in the resistor. Thus, dBu is numerically equal to dBm when measuring in a 600 ohm circuit.

% Modulation (FM context): 100 percent modulation is equivalent to a 75 kHz frequency deviation

F. Appendix F - Spectrum Characterization

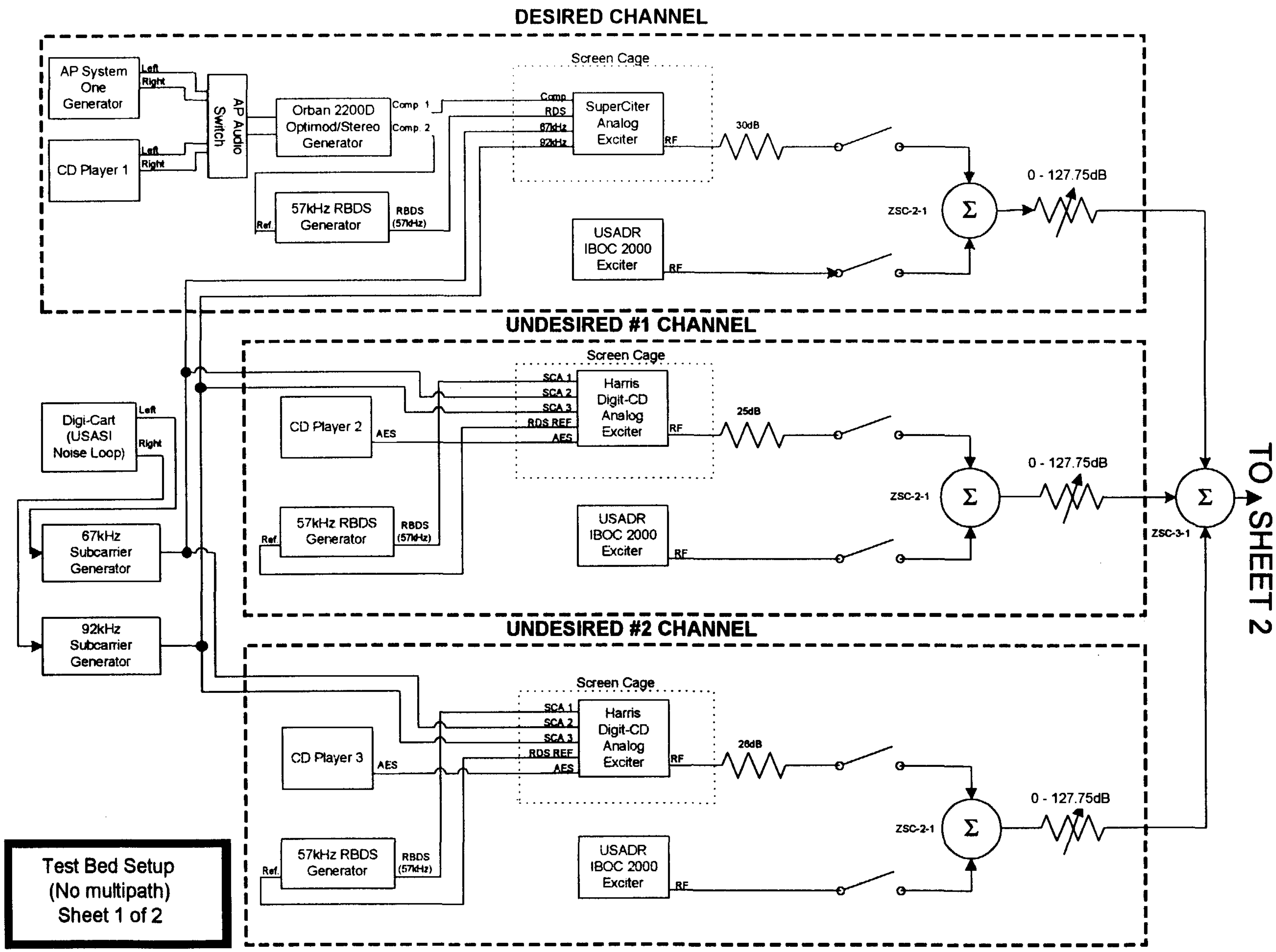
The ATTC Test Bed provides limited RF shielding to prevent signal ingress. Also electrostatic screen enclosures shall be utilized to further control signal ingress. The choice of main carrier frequency for FM is therefore based upon the following criteria:

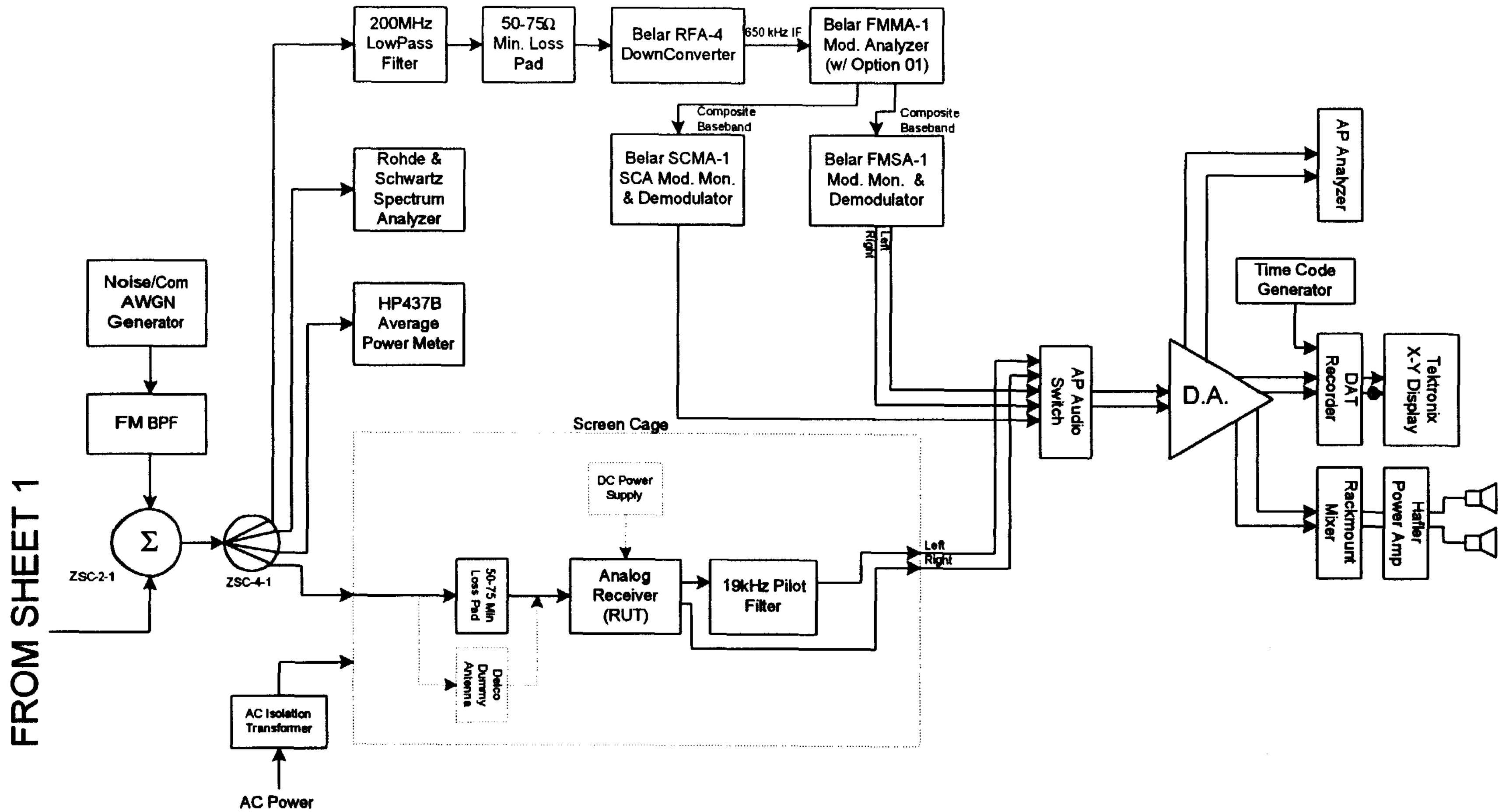
- At or near the center of the FM band
- Within a quiet portion of the spectrum

The selection of carrier frequency is subject to change if significant ingress is observed.

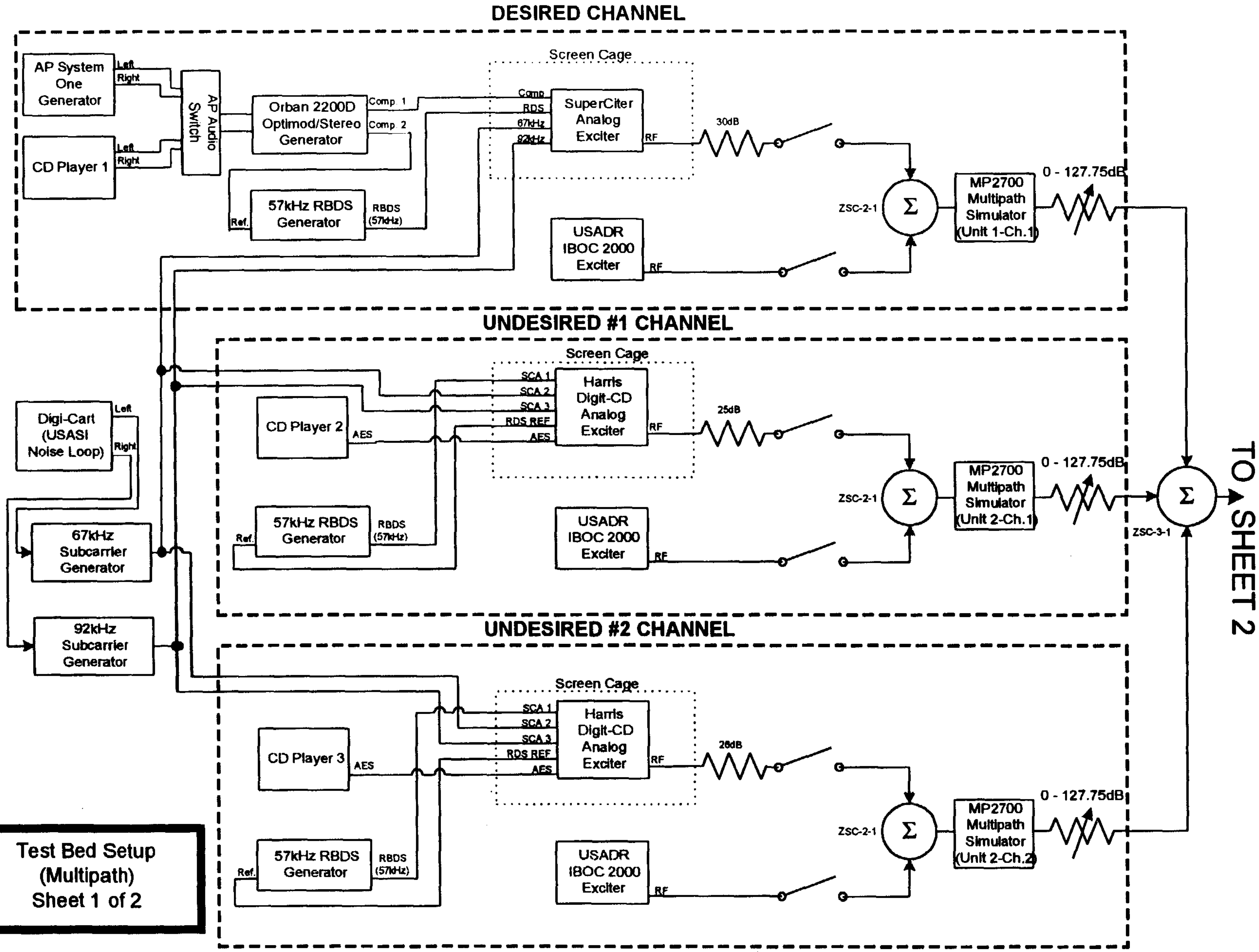
G. Appendix G – Test Bed Diagrams

This appendix contains diagrams of the test bed to be used for all of the preceding tests. Please note that there are slightly different configurations, dependent on whether the test includes multipath scenarios.

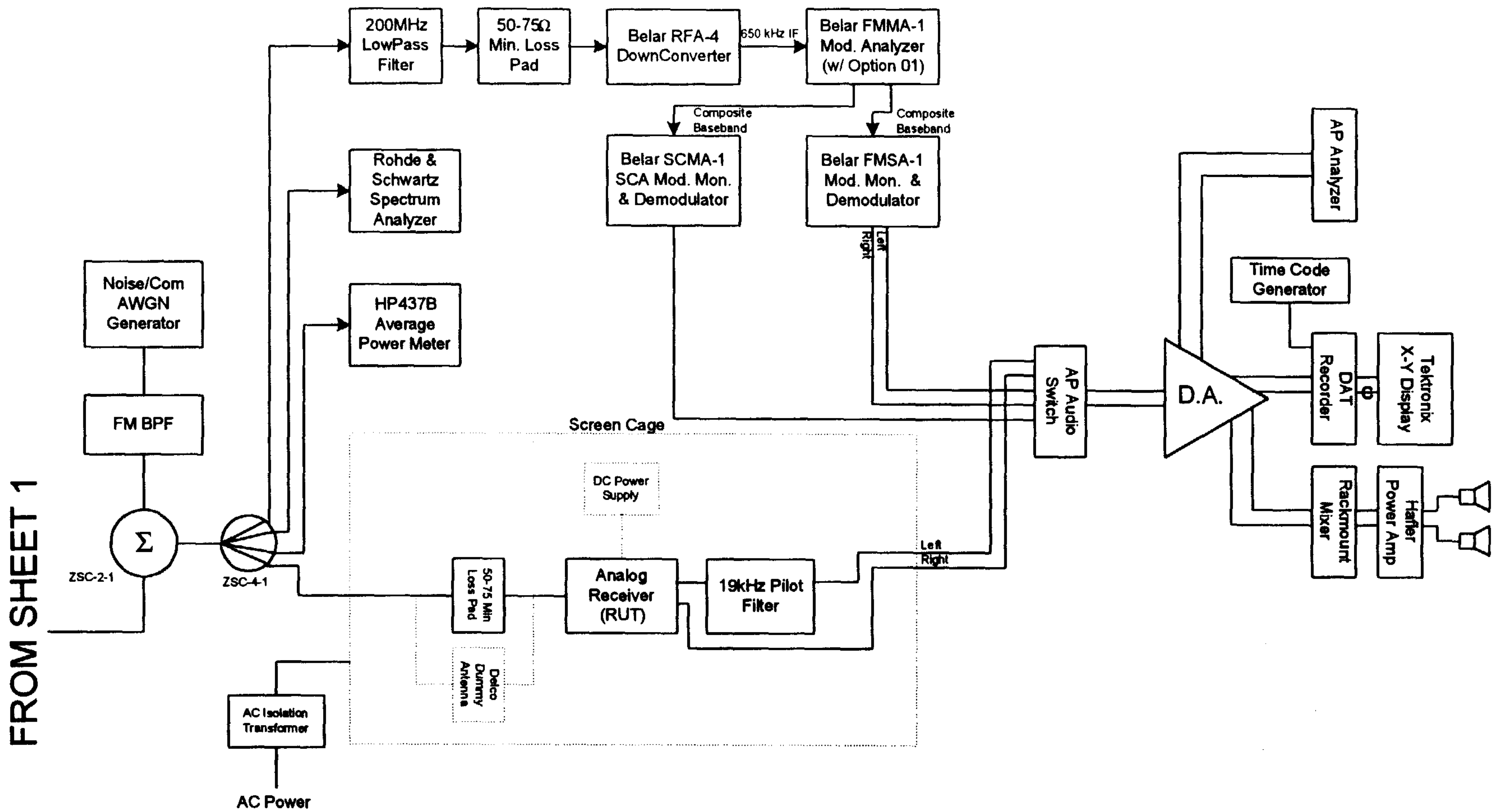

DESIRED CHANNEL
AP System One Generator
Left
Right
CD Player 1
Left
Right
AP Audio Switch
Orban 2200D Optimod/Stereo Generator
Comp. 1
Comp. 2
57kHz RBDS Generator
Ref.
RBDS (57kHz)
Screen Cage
Comp
RDS
67kHz
92kHz
SuperCiter Analog Exciter
RF
30dB
USADR IBOC 2000 Exciter
RF
ZSC-2-1
0 - 127.75dB
UNDESIRED #1 CHANNEL
Screen Cage
SCA 1
SCA 2
SCA 3
RDS REF
AES
Harris Digit-CD Analog Exciter
RF
25dB
CD Player 2
AES
57kHz RBDS Generator
Ref.
RBDS (57kHz)
USADR IBOC 2000 Exciter
RF
ZSC-2-1
0 - 127.75dB
ZSC-3-1
TO SHEET 2
Digi-Cart (USASI Noise Loop)
Left
Right
67kHz Subcarrier Generator
92kHz Subcarrier Generator
UNDESIRED #2 CHANNEL
Screen Cage
SCA 1
SCA 2
SCA 3
RDS REF
AES
Harris Digit-CD Analog Exciter
RF
28dB
CD Player 3
AES
57kHz RBDS Generator
Ref.
RBDS (57kHz)
USADR IBOC 2000 Exciter
RF
ZSC-2-1
0 - 127.75dB
Test Bed Setup (No multipath) Sheet 1 of 2



Test Bed Setup
(No multipath)
Sheet 2 of 2



Test Bed Setup (Multipath) Sheet 1 of 2



Test Bed Setup
(Multipath)
Sheet 2 of 2

Appendix F

Effect of Varying DAB Levels on FM Analog Compatibility

1. Overview

Of paramount importance in the design of a viable IBOC system is the compatibility of the new digital signals with existing analog service. USADR is carefully investigating the optimal spectral placement and power levels of its FM DAB sidebands to ensure superior digital audio performance while minimizing the impact to existing analog signals. Toward this end, USADR has performed a number of laboratory experiments to measure the degradation of an analog FM signal in the presence of hybrid IBOC sidebands, first adjacent hybrid IBOC signals, and selective fading. In particular, the following tests were performed using three representative, commercial FM receivers:

- Analog Deterioration. This test measures the signal strengths at which the candidate receivers begin to degrade and fail in the existing analog environment. Besides setting baseline analog performance, it provides a useful barometer for evaluating digital coverage.

- Comparison of Analog Co-Channel and Digital First Adjacent Interference. This test compares desired analog signal compatibility with an existing analog co-channel to the compatibility of a first adjacent hybrid IBOC interferer whose DAB sidebands present equivalent co-channel interference to the desired signal. It provides motivation for investigating the effects of increasing DAB power above the –22 dB_{host} baseline.[1]

- Host Compatibility. This test measures the degradation introduced to the host analog signal by its IBOC DAB sidebands. Besides measuring the analog audio SNR of a *baseline IBOC* signal, the test also finds the levels of the DAB sidebands at which the candidate receivers begin to degrade and fail.

- First adjacent Compatibility. This test measures the degradation introduced to the desired analog signal by a first adjacent hybrid IBOC signal. In addition to measuring the analog audio SNR of the desired IBOC signal in the presence of a *baseline IBOC* first adjacent interferer, the test also finds the levels of the adjacent DAB sidebands at which the candidate receivers begin to degrade and fail.

This report will describe the test procedures, present the results, and draw conclusions on the impact of varying DAB power level on existing analog service.

[1] Second adjacent channel compatibility is addressed in Appendix E.

2. Procedures

2.1 Definitions

A number of terms used regularly throughout this report are defined below.

- The *baseline DAB* signal has total power 22 dB below the total power in the analog host FM signal.
- The *baseline FM* signal consists of a pilot channel and a main audio channel modulated by *processed pop music*. (There are no SCAs).
- The combination of *baseline DAB* and *baseline FM* signals produces the *baseline IBOC* signal.
- The *processed pop music* is The Wallflowers, "I Wish I Felt Nothing". The audio processing is provided by an Orban Optimod 8200 with a "Rock-Dense" setting.
- A *quiet FM* signal is defined as modulation by the pilot only (10%), with no left or right audio inputs.
- A *maximum first adjacent channel* is defined as a *baseline IBOC channel* which is transmitted 200 kHz from the desired channel, with total power 6 dB below the total power of the desired FM channel, but modulated with *processed pink noise*.
- *TOA* is defined as the threshold of audibility, which is the point at which the analog signal of interest begins to exhibit audible degradation.
- *POF* is defined as the point of failure, where the analog signal of interest degrades to a point where the listener would tune to another station.
- *Processed pink noise* is simply white Gaussian noise that has been filtered with a 3 dB/octave rolloff and is subsequently processed using an Orban FM Optimod 2200D. The pink noise was generated by the Audio Precision System Two 2322. The Optimod processing settings were :

EQ		
↓→	30HzHPF = In	
	LOW BASS = +2 dB	
	HF ENHANCE = +2	
FULL CONTROL		
↓→	GATE THR = -40 dB	
	AGC = On	
	AGC DRIVE = 10 dB	
	2B DRIVE = 12 dB	
	REL TIME = +1 dB/sec	
	BASS COUPL = 0 %	
	HF LIMIT = 0.0	
	CLIPPING = +0.5	
	FINAL CLIP = 0.0	

2.2 General Methodology

To verify compatibility of FM IBOC DAB with existing analog service, USADR randomly selected receivers from each of three major classes of commercially available FM radios:

(1) Home HiFi – Yamaha HTR-5130
(2) Car Stereo – Pioneer KEH-P2800
(3) Boombox – Philips Magnavox AZ1020

An RF signal was delivered to each receiver over coaxial cable through a BNC connector.[2] TOA and POF were determined by subjective, critical listening tests. Headphones were used for listening to the home HiFi; however, speakers were used for listening to the car stereo and boombox, since this better reflects actual listening habits.

The host and first adjacent analog FM signals were generated by a Harris THE-1 FM exciter and/or Sencore SG-80 FM Stereo Analyzer, and the DAB digital sidebands were generated using a USADR FM IBOC DAB Exciter.

Audio signal-to-noise ratio (SNR) was measured using an HP89440A Vector Signal Analyzer (VSA). The SNR was measured by the VSA in a 150 Hz bandwidth around a 1 kHz audio tone at the left or right audio channel output of the receiver. The audio SNR measured by the VSA was then scaled to a 15 kHz bandwidth.

Only the car stereo was tested in selective fading, since the other receivers are not typically used in a mobile environment. The Electronic Industries Association (EIA) 9-

[2] The boombox was modified to accept the signal in this manner.

ray "Urban Fast" Rayleigh multipath fading profile was used.[3] This profile is shown in the table below.

Urban Fast Rayleigh Multipath Profile			
Ray	**Delay (microseconds)**	**Doppler (Hz)**	**Attenuation (dB)**
1	0.0	5.2314	2.0
2	0.2	5.2314	0.0
3	0.5	5.2314	3.0
4	0.9	5.2314	4.0
5	1.2	5.2314	2.0
6	1.4	5.2314	0.0
7	2.0	5.2314	3.0
8	2.4	5.2314	5.0
9	3.0	5.2314	10.0

This fading profile was generated in the laboratory using a Noise/Com MP2700 Multipath Fading Emulator. Both desired and interfering signals were independently faded per this profile.

To cover a wide range of signal levels, the tests were performed with desired signal strengths of 34, 54, and 74 dBu. Conversion from dBu into dBm at the receiver input is as follows. Assuming a mid-band carrier frequency of 100 MHz and a dipole antenna of unity gain (due to ground-plane losses, etc.), electric field intensity E (V/m) can be converted to carrier power C (W) at the input to the receiver using

$$C = \frac{E^2}{120\pi} A_e$$

where

$$A_e = \frac{\lambda^2}{4\pi} G$$

In this case, $A_e = 0.716\ m^2$ is the effective aperture of the unity-gain dipole antenna. Using this formula, a 54 dBu field strength corresponds to a –63.2 dBm carrier power. Likewise, 74 dBu and 34 dBu field strengths correspond to –43.2 dBm and –83.2 dBm carrier powers, respectively.

In addition, to encompass a broad range of ambient noise levels, the tests were performed in Gaussian noise environments of 10,000K and 100,000K. To convert from noise temperature in degrees K to noise power in dBm/Hz, the following formula is used:

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[3] In 1993, the EIA conducted multipath characterization tests in Salt Lake City, and subsequently created four "profiles" that are descriptive of the multipath environment. The urban fast profile simulates driving at approximately 35 mph through a city street.